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MEASUREMENT OF SELECTED CHEMICALS IN SOIL FROM THE DEAD CREEK SITE - CERRO COPPER COMPANY

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ABSTRACT: Four sediment samples were taken on September 22, 1980 by Monsanto representatives. The samples were transferred to our laboratory and analyzed for polychlorinated biphenyls, elemental phosphorus, chlorobenzenes, chlorophenols, phosphate esters, and metals (including arsenic and inorganic phosphorus). Varying amounts of the organic chemicals and metals were measured in the soil samples. Some metals, e.g., copper, iron, lead and zinc were present at levels well above those in the Missouri Bottoms soil used as a control.

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MEASUREMENT OF SELECTED CHEMICALS IN SOIL FROM THE DEAD CREEK SITE-
CERRO COPPER COMPANY

INTRODUCTION

Following media reports and subsequent Illinois EPA concern about hazardous chemicals at the Dead Creek site near Sauget, Illinois, personnel from Monsanto's W. G. Krummrich Plant sampled several areas on the property of Cerro Copper Company, north of the site. The samples were submitted to Environmental Sciences for characterization. Monsanto's concerns about the site arose from reports of high levels of polychlorinated biphenyls and phosphorus, as well as the reported presence of other chemicals, and the proximity of the site to the Krummrich Plant. In addition to polychlorinated biphenyls and phosphorus, several other "families" of chemicals were measured to try to identify or eliminate possible sources of the chemicals at the site. These samples were taken to determine if the source of metals in the site could be related to Cerro Copper Company operations.

SUMMARY

Four sediment samples were taken on September 22, 1980 by Monsanto representatives. The samples were transferred to our laboratory and analyzed for polychlorinated biphenyls, elemental phosphorus, chlorobenzenes, chlorophenols, phosphate esters, and metals (including arsenic and inorganic phosphorus). Varying amounts of the organic chemicals and metals were measured in the soil samples. Some metals, e.g., copper, lead and zinc were present at levels well above those in the Missouri Bottoms soil used as a control.

DETAILS

Sampling

The four soil samples were collected by Monsanto W. G. Krummrich plant personnel. The samples were transferred to the Environmental Analysis Group. In our laboratory, the sediment samples were handled according to Standard Operating Procedure (SOP) EAN-80-SOP-6, Homogenizing, Subdividing and Preserving Sediment Samples. Portions of the soil samples were transferred to Applied Sciences for the determination of metals and arsenic.

Analytical Procedures

The four soil samples were analyzed for a variety of chemicals using established procedures or methods developed and validated for the chemicals of interest in soil. The following list tabulates the methods which were used.

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Analyte	Method No.	Title
Polychlorinated Biphenyls	ES-80-M-28	Determination of Polychlorinated Biphenyls in Soil and Sediment
Chlorinated Benzenes	ES-80-M-29	Determination of Chlorinated Benzenes in Soil and Sediment
Chlorinated Phenols	ES-80-M-30	Determination of Chlorinated Phenols in Soil and Sediment
Elemental Phosphorus	ES-80-M-24	Determination of Elemental Phosphorus (P ₄) in Soil and Sediment
Phosphate Esters	ES-80-M-5	Determination of Group I Compounds in Sediments
Metals	Ref. 1, 2	Inductively Coupled Plasma (ICP) ... Method for Trace Element Analysis of Water and Wastes
Arsenic	Ref. 3	Methods for Chemical Analysis of Water and Wastes - Arsenic

All determinations were carried out in strict accordance with these methods, except that the polychlorinated biphenyls, chlorinated benzenes and phosphate esters were measured in extracts from acidified samples to facilitate determination of chlorinated phenols in the same extracts.

Results

The analytical results for this study are tabulated in Tables I-VI. Each table contains the results for all of the samples for a specific group of compounds. All results for the soils are in ppm (parts per million or $\mu\text{g/g}$). In general, the stated detection limits are the lowest level at which a given measurement was validated. Levels which are apparently real, but which are below the validated detection limit are presented in parentheses.

Quality Assurance

The quality assurance results (i.e., recovery and precision evaluations) for these samples have been compiled along with those of similar samples analyzed concurrently. These results are reported in Special Study ES-80-SS-27, Measurement of Selected Chemicals in Soil from the Dead Creek Site - Quality Assurance.

REFERENCES

1. Methods for Chemical Analysis of Waters and Wastes, EPA-600/4-79-020, page: Metals - 6, Section 4.1.3.
2. Federal Register, Vol. 44, No. 233, December 3, 1979.
3. Methods for Chemical Analysis of Waters and Wastes, EPA-600/4-79-020, Method 206 - Arsenic, pages: 206.2-1 to 206.5-2.

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TABLE I. PPM LEVELS OF PCBs AND ELEMENTAL PHOSPHORUS (P₄) IN DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO.	0092412	0092413	0092414	0092415	0041701
	DATE SAMPLED	9/22/80	9/22/80	9/22/80	9/22/80	4/16/80
	LOCATION	1N - Cerro Copper Co.	2N - Cerro Copper Co.	3S - Cerro Copper Co.	4S - Cerro Copper Co.	Soil Blank Mo. Bottoms St. Charles, MO.
PCB's (Cl ₂ to Cl ₆ Homologs)		530	4.1	410	150	ND<1
P ₄		ND<1	ND<1	ND<1	ND<1	ND<1

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TABLE II. PPM LEVELS OF CHLOROBENZENES IN DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO. DATE SAMPLED LOCATION	0092412 9/22/80 1N - Cerro Copper Co.	0092413 9/22/80 2N - Cerro Copper Co.	0092414 9/22/80 3S - Cerro Copper Co.	0092415 9/22/80 4S - Cerro Copper Co.	0041701 4/16/80 Soil Blank Mo. Bottoms St. Charles, MO.
MONOCHLOROBENZENE		4.0	ND<1	1.6	(0.1)	ND<1
P-DICHLOROBENZENE		160	(0.3)	23	1.7	ND<1
O-DICHLOROBENZENE		210	(0.2)	11	(0.4)	ND<1
TRICHLOROBENZENES (3)		14	2.5	47	29	ND<1
TETRACHLOROBENZENES (3)		10	4.9	25	6.7	ND<1
PENTACHLOROBENZENE		2.4	1.1	10	1.0	ND<1
HEXACHLOROBENZENE		3.5	ND<1	ND<3	(0.3)	ND<1
NITROCHLOROBENZENES (O-, P-)		ND<1	ND<1	ND<50	ND<1	ND<1

() Values in parentheses are below the validated detection limit. However, they represent levels detected with a S/N >2.5 and can be considered semi-quantitative.

TABLE III. PPM LEVELS OF CHLOROPHENOLS IN DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO.	0092412	0092413	0092414	0092415	0041701
	DATE SAMPLED	9/22/80	9/22/80	9/22/80	9/22/80	4/16/80
	LOCATION	1N -	2N -	3S -	4S -	Soil Blank
		Cerro	Cerro	Cerro	Cerro	Mo. Bottoms
		Copper Co.	Copper Co.	Copper Co.	Copper Co.	St.Charles, MO.
O-CHLOROPHENOL		1.0	ND<1	ND<1	ND<2	ND<1
P-CHLOROPHENOL		ND<1	ND<1	2.4	1.8	ND<1
2,4-DICHLOROPHENOL		2.1	ND<1	ND<1	ND<2	ND<1
PENTACHLOROPHENOL		7.6	ND<1	ND<5	5.0	ND<1

() Values in parentheses are below the validated detection limit. However, they represent levels detected with a S/N >2.5 and can be considered semi-quantitative.

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TABLE IV. PPM LEVELS OF PHOSPHATE ESTERS IN DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO. DATE SAMPLED LOCATION	0092412 9/22/80 1N - Cerro Copper Co.	0092413 9/22/80 2N - Cerro Copper Co.	0092414 9/22/80 3S - Cerro Copper Co.	0092415 9/22/80 4S - Cerro Copper Co.	0041701 4/16/80 Soil Blank Mo. Bottoms St.Charles,MO.
DIBUTYLPHENYL PHOSPHATE		1.9	ND<1	ND<1	ND<1	ND<1
BUTYLDIPHENYL PHOSPHATE		3.2	ND<1	3.4	1.6	ND<1
TRIPHENYL PHOSPHATE		40	ND<1	ND<1	1.7	ND<1
2-ETHYLHEXYLDIPHENYL PHOSPHATE		10	ND<1	1100	8.1	ND<1
ISODECYLDIPHENYL PHOSPHATE		ND<1	ND<1	ND<1	ND<1	ND<1
T-BUTYLPHENYLDIPHENYL PHOSPHATE		550	1.1	ND<1	ND<1	ND<1
DI-T-BUTYLPHENYLPHENYL PHOSPHATE		280	1.3	1.0	ND<1	ND<1
NONYLPHENYLDIPHENYL PHOSPHATE		980	12	4.3	3.1	ND<1
CUMYLPHENYLDIPHENYL PHOSPHATE		440	3.8	5.6	4.7	ND<1

() Values in parentheses are below the validated detection limit. However, they represent levels detected with a S/N >2.5 and can be considered semi-quantitative.

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TABLE V. PPM LEVELS OF METALS IN DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO. DATE SAMPLED LOCATION	0092412 9/22/80 1N - Cerro Copper Co.	0092413 9/22/80 2N - Cerro Copper Co.	0092414 9/22/80 3S - Cerro Copper Co.	0092415 9/22/80 4S - Cerro Copper Co.	0041701 4/16/80 Soil Blank Mo. Bottoms St.Charles, MO.
SILVER		8.0	17	44	46	ND<1
ALUMINUM		1900	1800	4600	2600	5600
BARIUM		1500	210	1700	1900	120
BERYLLIUM		1.8	11	ND<1	ND<1	ND<1
BORON		92	460	180	100	27
CALCIUM		9600	1600	28,000	6500	4600
CADMIUM		34	180	56	37	3.9
COBALT		99	530	300	120	33
CHROMIUM		128	180	580	360	19
COPPER		15,000	17,000	29,000	21,000	19
IRON		35,000	24,000	70,000	48,000	9900
MAGNESIUM		1300	340	3600	1500	2300
MANGANESE		100	71	280	120	510
MOLYBDENUM		38	96	74	43	11
SODIUM		320	293	430	330	320
NICKEL		310	2000	2400	890	39
LEAD		1600	4600	2200	2000	50
PHOSPHORUS		6600	5900	12,000	6500	610
ANTIMONY		60	190	130	78	29
SILICON		110	220	110	72	110
TIN		270	990	350	260	18
STRONTIUM		56	15	100	57	17
TITANIUM		59	19	36	41	37
VANADIUM		59	49	140	76	130
ZINC		2100	6400	8800	5300	56
ARSENIC (By AA)		80	80	200	140	5

TABLE VI. SUMMARY OF PHOSPHORUS CONTENT (PPM) OF DEAD CREEK SOIL SAMPLES

ANALYTE	ES LOG NO.	0092412	0092413	0092414	0092415	0041701
	DATE SAMPLED	9/22/80	9/22/80	9/22/80	9/22/80	4/16/80
	LOCATION	1N -	2N -	3S -	4S -	Soil Blank
		Cerro	Cerro	Cerro	Cerro	Mo. Bottoms
		Copper Co.	Copper Co.	Copper Co.	Copper Co.	St. Charles, MO.
P - ELEMENTAL, By GC/MS		ND<1	ND<1	ND<1	ND<1	ND<1
P-INORGANIC, By ICP		6600	5900	12,000	6500	610
TOTAL PHOSPHATE ESTERS By GC/MS		2300	18	1100	19	ND<10

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